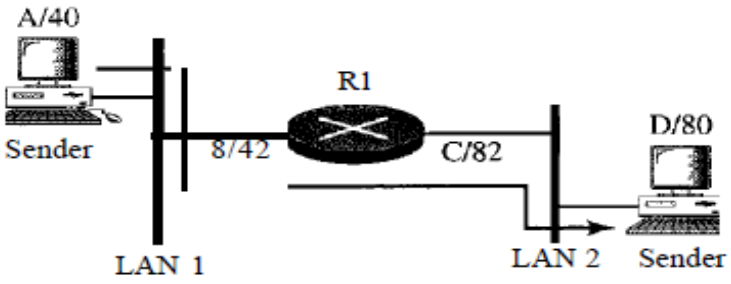
UNIT-I

1. Let us use a circuit-switched network to connect eight telephones in a small area. Communication is through 4-kHz voice channels. We assume that each link uses FDM to connect a maximum of two voice channels. The bandwidth of each link is then 8 kHz Telephone 1 is connected to telephone 7; 2 to 5; 3 to 8; and 4 to 6. Of course the situation may change when new connections are made. Show the switch controls the connections.
2. Consider a circuit-switched network that connects computers in two remote offices of a private company. The offices are connected using a T-1 line leased from a communication service provider. There are two 4 × 8 (4 inputs and 8 outputs) switches in this network. For each switch, four output ports are folded into the input ports to allow communication between computers in the same office. Four other output ports allow communication between the two offices. Show the connections using the diagram.
3. If a periodic signal is decomposed into five sine waves with frequencies of 100, 300, 500, 700, and 900 Hz, what is its bandwidth? Draw the spectrum, assuming all components have maximum amplitude of 10 V.
4. The power we use at home has a frequency of 60 Hz (50 Hz in Europe). Find the period.
5. The wavelength is normally measured in micrometers (microns). For example, the wavelength of the frequency of red light is 4×10^{14}. Find the wavelength of red light in air.
6. Consider a noiseless channel with a bandwidth of 3000 Hz transmitting a signal with two signal levels. Find the maximum bit rate. Consider the same noiseless channel transmitting a signal with four signal levels (for each level, we send 2 bits). Find the maximum bit rate in this case.
7. Consider an extremely noisy channel in which the value of the signal-to-noise ratio is almost zero. In other words, the noise is so strong that the signal is faint. For this channel the find capacity of the channel.
8. We can calculate the theoretical highest bit rate of a regular telephone line. A telephone line normally has a bandwidth of 3000. The signal-to-noise ratio is usually 3162. Find the capacity of this channel.
9. A network with bandwidth of 10 Mbps can pass only an average of 12,000 frames per minute with each frame carrying an average of 10,000 bits. What is the throughput of this network?
10. The distance between the two points is 12,000 km. Assume the propagation speed to be 2.4 × 108 m/s in cable. Find the propagation time.
11. Calculate the propagation time and the transmission time for a 5-Mbyte message (an image) if the bandwidth of the network is 1 Mbps? Assume that the distance between the sender and the receiver is 12,000 km and that light travels at 2.4×10^8 m/s.
12. An analog signal carries 4 bits per signal element. If 1000 signal elements are sent per second, find the bit rate.
13. Identify the five components of a data communications system. Discuss each component.
14. Outline the three criteria necessary for effective and efficient network.
15. A **network topology** is the arrangement of nodes -- usually switches, routers, or software switch/router features -- and connections in a **network**, often represented as a graph. Explain different types of network topology. Outline its advantages and disadvantages.
16. Suppose there are **n** devices in a network. What is the number of cable links required for a mesh, ring, bus, and star topology?

17. You have two computers connected by an Ethernet hub at home. Is this a LAN, a MAN, or a WAN? Explain your reason.
18. Performance is inversely related to delay. When you use the Internet, which of the following applications are more sensitive to delay?
    a. Sending an e-mail
    b. Copying a file
    c. Surfing the Internet
19. When a party makes a local telephone call to another party, is this a point-to-point or multipoint connection? Explain your answer.
20. Four levels of addresses are used in an internet employing the TCP/IP protocols. Explain each type of addressing.
21. How are OSI and ISO related to each other? Discuss with neat sketch the function of each layers in OSI.
22. In Figure below, computer A sends a message to computer D via LANl, router Rl, and LAN2. Show the contents of the packets and frames at the network and data link layer for each hop interface.



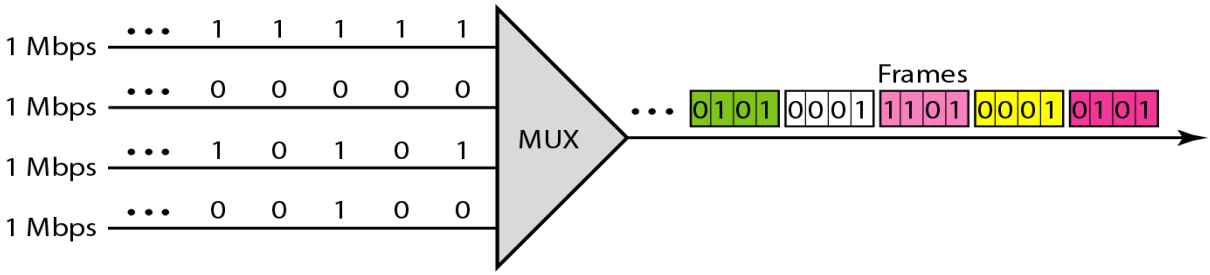
23. Suppose a computer sends a packet at the network layer to another computer somewhere in the Internet. The logical destination address of the packet is corrupted. What happens to the packet? How can the source computer be informed of the situation?
24. Assume we need to download text documents at the rate of 100 pages per minute. What is the required bit rate of the channel? A digitized voice channel is made by digitizing a 4-kHz bandwidth analog voice signal. We need to sample the signal at twice the highest frequency (two samples per hertz). We assume that each sample requires 8 bits. What is the required bit rate?
25. The power of a signal is 10 mW and the power of the noise is 1 /lW; what are the values of SNR and SNRdB?
26. We have a channel with a I-MHz bandwidth. The SNR for this channel is 63. What are the appropriate bit rate and signal level?
27. If the bandwidth of the channel is 5 Kbps, how long does it take to send a frame of 100,000 bits out of this device?
28. Outline the key differences between TCP/IP and OSI reference model.
29. What is the number of bits per baud for the following techniques?
    a. ASK with four different amplitudes
    b. FSK with 8 different frequencies
    c. PSK with four different phases

30. Discuss the various techniques for digital to analog conversion.
31. Discuss the various techniques for analog to analog conversion.
32. Discuss the various techniques for analog to digital conversion.
33. Outline the various developments that took place between 1960's to 1995 in the evolution of the Internet.
34. Discuss guided and un-guided media in detail.
35. List and explain some application layer protocol (any two).
36. Compare and contrast PCM and DM.
37. Define the following (a) Periodic and non-Periodic signal (b) Phase (c) Frequency (d) Bandwidth (e) Bit rate (f) Baud rate (g) Throughput (h) Latency (delay) (i) Jitter (j) Noise (k) Attenuation (l) Distortion (m) Bit length (n) Analog signal (o) Digital Signal
38. Discuss the different transmission modes.
39. Explain the mode of communication.
40. Explain the differences between ns2 and ns3 simulator.

UNIT-II

1. List and explain the different Line coding Schemes.
2. Draw the waveform for the digital data 110010 using the following schemes
   a. Unipolar NRZ
   b. Polar NRZ-L and NRZ-I
   c. Polar RZ
   d. Polar Manchester and Differential Manchester
   e. Bipolar AMI and Pseudoternary
3. Draw the waveform for the digital data 10110001 using the following line coding schemes
   a. Unipolar NRZ
   b. Polar NRZ-L and NRZ-I
   c. Polar RZ
   d. Polar Manchester and Differential Manchester
   e. Bipolar AMI and Pseudoternary
4. Distinguish between a signal element and a data element.
5. Define DC component and its effect on digital transmission.
6. We have a baseband channel with a 2-MHz bandwidth. Calculate the data rate of this channel in case of NRZ-L line coding scheme.
7. We have a baseband channel with a 1-MHz bandwidth. Calculate the data rate of this channel in case of Manchester line coding scheme.
8. Draw the graph of the NRZ-I schemes using each of the following data streams, assuming that the last signal level has been positive. From the graph guess the bandwidth for this scheme using the average number of changes in the signal level.
   00000000 b. 11111111 c. 01010101 d. 00110011
9. Assume that a voice channel occupies a bandwidth of 4 kHz. We need to combine three voice channels into a link with a bandwidth of 12 kHz, from 20 to 32 kHz. Show the configuration, using the frequency domain. Assume there are no guard bands

10. Five channels, each with a 100-kHz bandwidth, are to be multiplexed together. What is the minimum bandwidth of the link if there is a need for a guard band of 10 kHz between the channels to prevent interference?
11. Figure shows synchronous TDM with a data stream for each input and one data stream for the output. The unit of data is 1 bit. Find (a) the input bit duration, (b) the output bit duration, (c) the output bit rate, and (d) the output frame rate.



12. Four channels are multiplexed using TDM. If each channel sends 100 bytes /s and we multiplex 1 byte per channel, show the frame traveling on the link, the size of the frame, the duration of a frame, the frame rate, and the bit rate for the link.
13. Four 1-kbps connections are multiplexed together. A unit is 1 bit. Find (a) the duration of 1 bit before multiplexing, (b) the transmission rate of the link, (c) the duration of a time slot, and (d) the duration of a frame.
14. List and explain the different networking devices.
15. Explain the different Spread spectrum technique.
16. In one of the type of spread spectrum, a transmitter “hops” between the available frequencies according to a predefined algorithm or program, which can be either randomly created or planned before being executed. Identify the type of spread spectrum and explain it.
17. Compare and Contrast FHSS and DSSS.
18. Identify and explain the spread spectrum which introduces rapid phase transition to the data to make it larger in bandwidth.
19. Discuss the different networking device.
20. Why we need multiplexing. Explain different types of multiplexing in detail.
21. We need a dataword of at least 7 bits. Calculate values of *k* and *n* that satisfy this requirement.
22. Which of the following *g(x)* values guarantees that a single-bit error is caught? For each case,
23. What is the error that cannot be caught?
    a. *x* + 1
    b. x3
    c. 1
24. Find the status of the following generators related to two isolated, single-bit errors.
    a) x+ 1
    b) x^4 + I
    c) x^7 + x^6 + 1
    d) x^ls +x^I4 +1
25. How can we represent the number 21 in one's complement arithmetic using only four bits? How can we represent the number -6 in one's complement arithmetic using only four bits?
26. Apply the exclusive-or operation on the following pair of patterns (the symbol EB
27. means XOR):
    a. (10001) EB (10000)
    b. (10001) EB (10001) (What do you infer from the result?)

c. (11100) EB (00000) (What do you infer from the result?)
d. (10011) EEl (11111) (What do you infer from the result?)

28. In Table 10.1, the sender sends dataword 10. A 3-bit burst error corrupts the codeword. Can the receiver detect the error? Defend your answer.
    In Table below, the sender sends dataword 10. A 3-bit burst error corrupts the codeword. Can the receiver detect the error? Defend your answer.

Dataword	**Codeword**
00	000
01	011
10	101
11	110

29. Using the code in Table below, what is the dataword if one of the following codewords is received?
    a. 01011
    b. 11111
    c. 00000
    d. 11011

Dataword	*Codeword*
00	00000
01	01011
10	10101
11	11110

30. **Error Correction** codes are used to **detect** and **correct** the errors when data is transmitted from the sender to the receiver. Discuss different types of error in Data communication. Consider the Data word to be sent as **100100** and generator as **1101.** Find the codeword and hence use CRC to find whether there is error or not.
31. If there is no dedicated link present then multiple stations can access the channel simultaneously. Hence multiple access protocols are required to decrease collision and avoid crosstalk. List the MAC Protocol and explain the Channelization Protocol.
32. Basic approach used for error detection is the use of redundancy, where additional bits are added to facilitate detection and correction of errors. List the popular technique and discuss internet checksum.
33. For the dataword 1001 find the codeword with generator 1011. Check at the receiver side whether the codeword is received correct or not.
34. Discuss PPP.
35. Framing is done at data link layer. Discuss framing in details.
36. One of the category in MAC protocol is Reservation Protocol. Discuss the its type.
37. A network with CSMA/CD protocol in the MAC layer is running at 1 Gbps over a 1 km cable with no repeaters. The signal speed in the cable is 2×10^8 m/sec. Calculate the minimum frame size for this network.
38. Compare and contrast a controlled access protocol with a channelizing protocol.

39. One hundred stations on a pure ALOHA network share a l-Mbps channel. If frames are 1000 bits long, find the throughput if each station is sending 10 frames per second.
40. In a CDMAlCD network with a data rate of 10 Mbps, the minimum frame size is found to be 512 bits for the correct operation of the collision detection process. What should be the minimum frame size if we increase the data rate to 100 Mbps? To 1 Gbps? To 10 Gbps?

UNIT-III

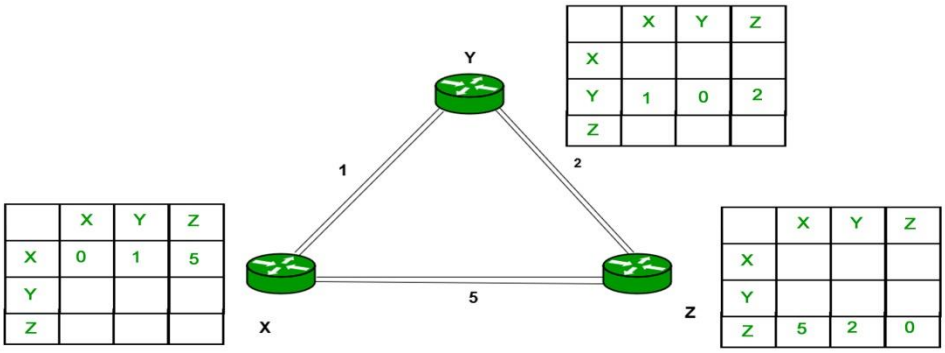
1. Each station on an Ethernet network (such as a PC, workstation, or printer) has its own network interface card (NIC). The NIC fits inside the station and provides the station with a 6-byte physical address. Identify the type of the following destination addresses:
   a) 4A:30:10:21:1O:1A
   b) 47:20:1B:2E:08:EE
   c) FF:FF:FF:FF:FF:FF
2. The address 43:7B:6C:DE: 10:00 has been shown as the source address in an Ethernet frame. The receiver has discarded the frame. Why?
3. An Ethernet MAC sublayer receives 42 bytes of data from the upper layer. How many bytes of padding must be added to the data?
4. Suppose the length of a lOB ase5 cable is 2500 m. If the speed of propagation in a thick coaxial cable is 200,000,000 m!s, how long does it take for a bit to travel from the beginning to the end of the network? Assume there are 10 /ls delay in the equipment.
5. Discuss the Ethernet standard.
6. Discuss the common Standard Ethernet implementations?
7. IEEE has defined the specifications for a wireless LAN, called IEEE 802.11, which covers the physical and data link layers. Discuss BSS and ESS.
8. Discuss MAC layer frame format.
9. Discuss the three types of mobility in a wireless LAN.
10. Use Table below to compare and contrast the fields in IEEE 802.3 and 802.11.

Fields	*IEEE 802.3 Field Size*	*IEEE 802.11 Field Size*
Destination address		
Source address		
Address 1		
Address 2		
Address 3		
Address 4		
FC		

11. The original Ethernet was created in 1976 at Xerox's Palo Alto Research Center (PARC). List and explain the frame format of 802.3 MAC frame.
12. Outline the concept of dividing the address space in case of classful IPV4 addressing. List and explain different classes. Identify the class of each address.

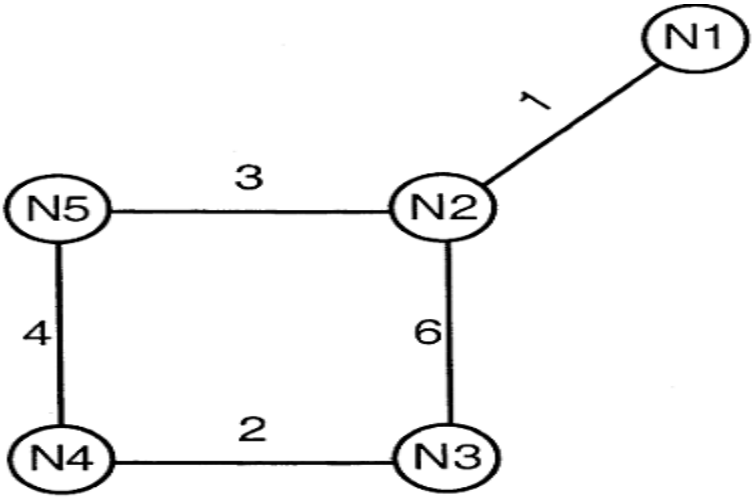
a) 00000001 00001011 00001011 11101111
b) 11000001 10000011 00011011 11111111
c) 14.23.120.8
d) 252.5.15.111

13. IPV4 consist of 32 bit and can be represented either in dotted decimal or binary format. Change the following IPv4 addresses from binary notation to dotted-decimal notation.
    a. 10000001 00001011 00001011 11101111
    b. 11000001 10000011 00011011 11111111
14. A distance-vector routing (DVR) protocol requires that a router inform its neighbors of topology changes periodically. Evaluate the following topology and give the final status of routing table at each node.

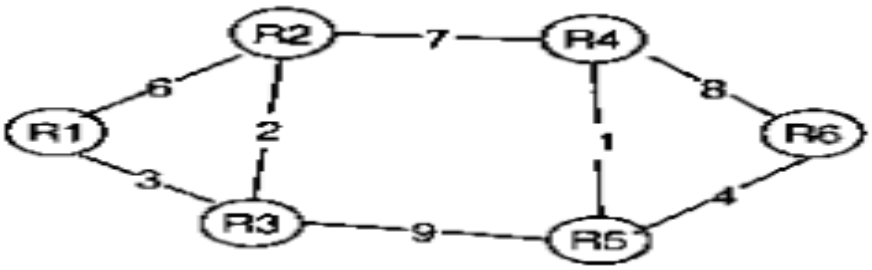


15. Discuss RIP protocol.
16. A block of addresses is granted to a small organization. We know that one of the addresses is 205.16.37.39/28. What is the first address in the block?
17. Compare and Contrast between classful addressing and classless addressing in IPv4?
18. Explain why most of the addresses in class A are wasted. Explain why a medium-size or large-size corporation does not want a block of class C addresses.
19. Briefly define subnetting and supemetting. How do the subnet mask and supemet mask differ from a default mask in classful addressing?
20. How can we distinguish a multicast address in IPv4 addressing? How can we do soin IPv6 addressing?
21. What is NAT? How can NAT help in address depletion?
22. What is the address space in each of the following systems?
    a. A system with 8-bit addresses
    b. A system with 16-bit addresses
    c. A system with 64-bit addresses
23. Find the netid and the hostid of the following IP addresses.
    a. 114.34.2.8
    b. 132.56.8.6
    c. 208.34.54.12
24. An organization is granted the block 16.0.0.0/8. The administrator wants to create 500 fixed-length subnets.
    a. Find the subnet mask.
    b. Find the number of addresses in each subnet.
    c. Find the first and last addresses in subnet 1.
    d. Find the first and last addresses in subnet 500.
25. An organization is granted the block 130.56.0.0/16. The administrator wants to create 1024 subnets.
    a. Find the subnet mask.
    b. Find the number of addresses in each subnet.
    c. Find the first and last addresses in subnet 1.
    d. Find the first and last addresses in subnet 1024.

26. An organization is granted the block 211.17.180.0/24. The administrator wants to create 32 subnets.
    a. Find the subnet mask.
    b. Find the number of addresses in each subnet.
    c. Find the first and last addresses in subnet 1.
    d. Find the first and last addresses in subnet 32.
27. An ISP is granted a block of addresses starting with 150.80.0.0/16. The ISP wants to distribute these blocks to 2600 customers as follows.
    a. The first group has 200 medium-size businesses; each needs 128 addresses.
    b. The second group has 400 small businesses; each needs 16 addresses.
    c. The third group has 2000 households; each needs 4 addresses.
    Design the subblocks and give the slash notation for each subblock. Find out how many addresses are still available after these allocations.
28. Show in hexadecimal colon notation the IPv6 address
    a. Compatible to the IPv4 address 129.6.12.34
    b. Mapped to the IPv4 address 129.6.12.34
29. Compare and Contrast IPV4 and IPV6 frame format.
30. Discuss the purpose of RIP? List RIP shortcomings and their corresponding fixes
31. Why do OSPF messages propagate faster than RIP messages?
32. A router using DVMRP receives a packet with source address 10.14.17.2 from interface 2. If the router forwards the packet, what are the contents of the entry related to this address in the unicast routing table?
33. Network layer does the task of routing. Discuss routing and its types.
34. Discuss the concept of path vector routing.
35. Discuss the concept of link state routing.
36. Discuss the difference between direct and indirect delivery.
37. Consider a network with five nodes, N1 to N5, as shown below.



    The network uses a Distance Vector Routing protocol. Find the distance vectors at different nodes once the routes have stabilized.
38. Consider a network with 6 routers R1 to R6 connected with links having weights as shown in the following diagram



All the routers use the distance vector based routing algorithm to update their routing tables. Each router starts with its routing table initialized to contain an entry for each neighbour with the weight of the respective connecting link. After all the routing tables stabilize, how many links in the network will never be used for carrying any data?

39. Discuss BGP.
40. Compare distance-vector and link-state routing protocols. What are the advantages of link-state routing compared to distance-vector routing?

UNIT-IV

1. Suppose a TCP connection is transferring a file of 5000 bytes. The first byte is numbered 1O,00l.
2. What are the sequence numbers for each segment if data are sent in five segments, each carrying
3. 1000 bytes?
4. A packet in TCP is called a segment. Explain the segment format.
5. What is the value of the receiver window *(rwnd)* for host A if the receiver, host B, has a buffer size of 5000 bytes and 1000 bytes of received and unprocessed data?
6. What is the size of the window for host A if the value of *rwnd* is 3000 bytes and the value of *cwnd* is 3500 bytes?
7. Are both UDP and IP unreliable to the same degree? Why or why not?
8. Do port addresses need to be unique? Why or why not? Why are port addresses shorter than IP addresses?
9. What is the dictionary definition of the word *ephemeral?* How does it apply to the concept of the ephemeral port number?
10. What is the minimum size of a UDP datagram?
11. What is the maximum size of a UDP datagram?
12. What is the minimum size of the process data that can be encapsulated in a UDP datagram?
13. What is the maximum size of the process data that can be encapsulated in a UDP datagram?
14. Compare the TCP header and the UDP header. List the fields in the TCP header that are missing from UDP header. Give the reason for their absence.
15. UDP is a message-oriented protocol. TCP is a byte-oriented protocol. If an application needs to protect the boundaries of its message, which protocol should be used, UDP or TCP?
16. A TCP connection is using a window size of 10,000 bytes, and the previous acknowledgment number was 22,001. It receives a segment with acknowledgment number 24,001 and window size advertisement of 12,000. Draw a diagram to show the situation of the window before and after.
17. TCP is connection oriented protocol. Discuss the format of a TCP segment elaborating on its different fields.

18. Suppose Host A sends two TCP segments back to back to Host B over a TCP connection. The first segment has sequence number 90; the second has sequence number 110.
    a. How much data is in the first segment?
    b. Suppose that the first segment is lost but the second segment arrives at B. In the acknowledgment that Host B sends to Host A, what will be the acknowledgment number?
19. Assume we need to design a Selective-Repeat sliding-window protocol for a network in which the bandwidth is 1 gbps and the average distance between the sender and receiver is 5,000km.Assume the average packet size is 50,000 bits and propagation speed is 2*10^8m.find the max size of the send and receive windows, the number of bits in the sequence number field and an appropriate time-out value for the timer?
20. Discuss TCP segment structure.
21. Define Congestion in network and explain how it be handled.
22. Discuss the concept of flow control in TCP
23. Discuss GoBack-N, Selective repeat N protocol
24. Discuss Client server programming.
25. Discus DNS.
26. Discuss SMTP.
27. Discuss TELNET.
28. Discuss the differences between TCP and UDP.
29. Discuss SCTP.
30. Discuss how error and flow control are taken care by TCP.